DOCUMENT RESUME

ED 411 218 SP 037 508

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TITLE What Makes for a Good Beginning? Improvising in an Elementary Mathematics Teacher Inquiry Group.
PUB DATE 1997-03-00
NOTE 41p.; Paper presented at the Annual Meeting of the American Educational Research Association (Chicago, IL, March 24-28, 1997).
CONTRACT ESI-9254479
PUB TYPE Reports - Research (143) -- Speeches/Meeting Papers (150)
EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS Change Strategies; *Discussion Groups; *Educational Improvement; Elementary Education; Elementary School Mathematics; Elementary School Teachers; *Inquiry; Inservice Teacher Education; *Mathematics Education; *Mathematics Teachers; *Reflective Teaching; Teacher Researchers

ABSTRACT

This paper describes and analyzes the experiences of an inquiry group that was part of a National Science Foundation-funded elementary mathematics teacher enhancement project, the "Mathematics for Tomorrow Project." Inquiry group meetings focused on discussions and interpretations of data that teachers have brought from their classrooms. A 3-member team worked on developing the design for this inquiry group. In preparation for each session, the members visited each others classrooms to gather data for later exploration. Some sessions included brainstorming about specific teaching activities, others were presentations, and others used vignettes. The vignettes proved to be the best trigger for focus group discussion. Participants seemed most able to connect with the vignettes which were short accounts of student interactions. Other observations during the course of the inquiry discussions led to additional insights. Creating a space of inquiry required the leader to be aware and attentive to the situation, have a perspective of where the teachers were in their own learning, and be emotionally aware of connections to and within the group. (Contains 13 references.) (JLS)

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What makes for a good beginning?
Improvising in an Elementary Mathematics Teacher Inquiry Group

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Paper presented at the annual meetings of the American Educational Research Association, Chicago, March 24, 1997. Support for the research and preparation of this paper was provided by NSF Grant No. ESI-9254479. The authors would like to thank Deborah Schifter for her helpful comments and suggestions.

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What makes for a good beginning?

Improvising in an Elementary Mathematics Teacher Inquiry Group

Annette Sassi, Amy Morse, & Lynn Goldsmith

Preface

For the last year and a half, one of the authors of this paper, Amy Morse, has facilitated a teacher inquiry group as part of a multi-year NSF-funded elementary mathematics teacher enhancement project. The other two, Lynn Goldsmith and Annette Sassi, have been researchers on the project, seeking to understand more deeply the nature of these inquiry groups and the work entailed for already practicing teachers to become more reflective and effective teachers of mathematics. This paper represents the thinking of all three of us. We have spent numerous hours discussing the development of Amy's group and the assumptions that underlie the moves she made as she came to make sense for herself what the work of this group was and could be. The paper is written through the interpretive lens of Annette, who framed the initial exploration, invited Amy and Lynn to engage in the dialogue, and took the responsibility for writing up the paper. It is a much smaller piece of investigation than initially proposed because, the more we discussed the issues, the more we realized that so much of the essence of the group resided in those early decisions and moves. By asking and attempting to answer the question, what makes for a good beginning, we found we had to look deeply at the assumptions, purposes, and goals of inquiry groups in general and their connection to the practice of teaching.

Introduction

The teaching of elementary mathematics has, within the last decade, undergone a tremendous amount of scrutiny and redefinition. Informed in part by constructivist theories of learning (see, for example von Glaserfeld, 1984, 1990; Cobb et al., 1991, 1992; Goldsmith & Schifter, 1994), teachers, researchers and teacher educators alike have set out to transform the practice of teaching

mathematics (see, for example, Schifter 1995; Schifter & Fosnot, 1993). There is some general sense that the practices of mathematics teaching and the mathematical knowledge necessary to engage in a reflective, principled, and student-informed teaching practice must be very different from that which many teachers often have. Furthermore, because this kind of teaching is not rule-governed and the decisions teachers must make cannot be prescribed, teachers must develop a keen sense of judgment to be ready to improvise in their classrooms (Sassi & Goldsmith, 1996).

Yet, there is also some understanding that teachers cannot take on this work in isolation. What teachers face in developing their practice is challenging and calls for supportive collaborative experiences in which they can take on this challenge with other colleagues. Teacher inquiry groups, where teachers can meet regularly to investigate issues in the teaching and learning of mathematics, are now becoming more prevalent . Questions remain, however, about how such groups can support this work and what structures or designs work best.

The paper begins with an overview of the Mathematics for Tomorrow Project and the teacher inquiry groups that are part of it. It next describes the development of one inquiry group within the project and the crafting of a structure that was workable for it. It then analyzes the choices and resulting characteristics of the group as a case of developing the practical judgment and "improvisational perception" necessary for the kind responsive teaching envisioned in reform efforts. It concludes with a consideration of several areas for further research that arise through this analysis.

The Mathematics for Tomorrow Project and Teacher Inquiry Groups

The Mathematics for Tomorrow (MFT) project is a multi-year systemically-embedded teacher enhancement project supported by the National Science Foundation. The project is based on the assumption that the kinds of changes called for in instructional practices require teachers to "examine long-standing beliefs about the nature of knowledge and learning, deepen their knowledge of the subject they teach, and reinvent their classroom practice from within a new conceptual frame." While teachers will still need to consider new teaching techniques and tools,

such as manipulatives, cooperative groups, and new questioning strategies , such techniques and tools must rest on a new understanding of the relationship between teaching and learning.

A central component in the design of the MFT project are school-based inquiry groups. As originally proposed, teachers were to meet bi-weekly in school-based groups to "engage in ongoing inquiry about their mathematics classes; develop new ideas about mathematics, learning, and teaching; and work collaboratively with supervisors, project staff, and each other to make changes in their classroom practice consistent with these new ideas." Meetings would focus on discussions and interpretation of data that teachers would bring from their classrooms. Such data could include student work, lesson plans with observations of what actually happened, journal entries, and "case studies" of individual students.

The form or structure of these groups would or could take was left open-ended. They were to be run as "communities of inquiry" where the inquiry would be into one's own practice of teaching mathematics. Structures were to evolve through the life of the group to meet the needs of participants.

The challenge of starting a new inquiry group

Amy Morse joined the MFT project as it began its third year. MFT had just finished its first two-year cycle and was starting its second and last two-year cycle with a new cohort of teachers. Amy would take responsibility for facilitating an inquiry group based in a mid-sized, middle income district in the greater Boston area. She had come to the project with ten years experience as an elementary school teacher as well as a history of experiences in a range of professional development projects.[1] Although she had had many experiences working with

[1]Amy credits several key teacher development projects in which she participated for significantly shaping her development as a teacher. She participated in the Boston Writing Project where she began to rediscover writing -- and the sharing of one's writing -- as a valuable means toward reflective learning. She also was a participant in "Talking Mathematics," co-directed by Susan Jo Russell and Becky Corwin of TERC. The purpose of this project was to help teachers learn how to engage in mathematics dialogue with the idea that teachers will need to know how to do this if they are to be able to engage students in it. Amy found this project to provide an opportunity to recapture her intrigue with and love of mathematics. Prior to and continuing while being a teacher educator on MFT, Amy participated in "Teaching to the Big Ideas" (TBI), co-directed by Deborah Schifter, Susan Jo Russell, and Virginia Bastable. This project has also made writing central to the exploration of children's mathematical thinking and the complexities inherent in the elementary mathematics curriculum. Amy had the unique opportunity to be

teachers as colleagues, the MFT project was her first experience working with teachers as a teacher educator.

The group was made up of nine teachers new to the MFT project as well as two teachers from the first cohort continuing on as "apprentice facilitators." These nine teachers had just participated in their first two week summer institute in which they explored a number of mathematical issues including place value and proportion, issues about how children learn and know mathematics, and issues pertaining to their own instructional practice including cooperative learning, classroom assessment, and classroom management.

The Inquiry Group Design -- The general inquiry groups structure, which was designed by the two other teacher educators on the project and Amy at the beginning of the new cycle, grew out of the previous two-year cycle and had two aspects to it. On certain weeks, two teachers would be the designated "focus" team and would bring in some questions about their mathematics teaching practice that were "dilemma filled"[2] and classroom data to support a collaborative investigation of the questions. In preparation for this session, they would visit each others' classrooms as a way of helping each other investigate the questions they had mutually decided to explore. Interspersed among these sessions would be ones with a mathematical "focus" where the facilitator would bring in mathematics for the group to do together.

Starting off -- At the first session, the group brainstormed questions or dilemmas that could form the basis of focus topics. Most of the questions were ones the teachers had about their own moves in the classroom as they were trying to figure out what this "new kind of teaching" was all about. Below are some of the questions they raised in their discussion:[3]

If you're in to an activity, when do you call it quits and should get on to the next thing?

> How do I relate these "projects" [e.g. an activity like "tangrams"] to the standard math curriculum. What is the bridge?

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concomitantly a teacher educator in one project and a teacher/participant in another and was able to use one to inform the other in her own developing practice.

[2]This structure was based significantly on the work of teacher researchers who studied their own teaching practice. See, for example Ball (1993) and Lampert (1989). Both researchers have contributed to the idea that teaching inherently is about making difficult choices in the moment.

[3]These questions are the actual words used by the teachers and transcribed from the audiotape of the session. Some slight modifications were made, noted by the brackets, for clarification purposes.

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> If I focus [on] using math logs and this whole process, what happens to the children next year [in] the next class if the focus is more traditional and the focus is based on skills.
>
> When [do I] stop the project and how I know that it has been understood by all. Do I just give a test at the end of this. Is there another assessment I can give, other than math journals? Is this the correct place to finish. I honestly don't know sometimes, have I gone too much on the subject and am I lacking something? Or have I not gone enough and do I have to continue on this?
>
> How do you get [students] into cooperative group work when [they] just don't want to work .. they just are too distracted by all the kids talking and working?
>
> How [do I] facilitate [both] computation skills and concept mastery with the exploration and discovery method and when and how [do I] incorporate direct instruction and how [do I] make evaluation?

Even as the teachers shared the questions that were most pressing on their minds about how to "do" this new kind of teaching, Amy was cautious about how much they should take on all at once. In a letter to them after this first session, she wrote, "I have been thinking about our Inquiry Group and want to explore here some of the foundations of the work we can do together. I also think there were enough issues raised during the first meeting concerning the complexities of teaching with new perspectives that it will be important for us to take our time, to insist that the session be useful and about learning, and to find ways to examine our work critically with an eye toward seeing new possibilities and not faults."

Beginning to feel "on the wrong track" -- Even with the first focus session, in which the two apprentice facilitators were the focus people, Amy began to wonder if this "structure" would allow the group to go where she hoped (and knew from experience) that they could go. The two teachers had put a lot of work into preparing a session on investigating the nature of questioning and exploring what makes for a good question. They had both brought data from their classrooms, made transcripts, and brought the mathematics for the group to do together.

Yet, as Amy noted in her reflections on the field notes, there were "many times the conversation dies." She noted that the topic "feels like a terribly unwieldy topic for teachers new to this point of view or frame of mind." There was something missing in the ways the group talked about questions, staying superficial and not being able to get specific.

Sensing that people might not connect to the focus topic without bringing something of their own, Amy modified the structure for the next focus session in which two new teachers would be bringing in data to support an investigation into the mathematical talk that could go on in a classroom. She asked the teachers to write a short account about something that happened in their classroom.[4] As she wrote to them,

> To support that investigation, the assignment for everyone in the Inquiry Group is to write up an episode, a vignette or a story of talk that went on in her own classroom. A description which, in part, includes the mathematical topic, the grade level and any other interesting and orienting information will be helpful. Describe to the reader what actually took place in your classroom. The writing assignment is to describe a time when you knew a child understood something you were teaching or a time when a child or a class surprised you. That surprise could come when you suddenly realize that you had assumed all along the children understood something and here was new evidence that they did not. Or surprise could come in the form of learning some new way of looking at a piece of mathematics that you had never considered yourself. This new way of seeing something may lead you to new ideas about the way your student or students think about or understand this topic.
>
> You might consider ending the story with your questions to the reader about what your next moves might be or by simply taking the reader to specific points and asking out loud, "What's going on here?" It is useful to be as specific as possible and include as much actual dialogue as you can record with some degree of accuracy. Feel free to attach other evidence of the children's thinking if it is available; a journal entry or drawings.

All but three non-focus teachers wrote vignettes or stories to complement the focus topic. A critical turning point came two inquiry groups later when Amy decided to have the group spend about half the session in small groups discussing their vignettes after the focus pair had presented their work.

The focus topic for the session was assessment. This session ended up being especially presentation-like where one of the focus teachers described the variety of assessment strategies she used. One of the apprentice facilitators described the session as similar to being at a graduate school presentation. The other was left feeling that the one focus teacher had come to the group with the intention of "instructing."

In contrast, the small group sharing of vignettes had a very different feel to it. People who were often quiet during the focus person sessions actually talked and shared stories from their own

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[4]This writing assignment was adapted from the writing assignments used in the Mathematics Process Writing Project, conducted by SummerMath for Teachers at Mount Holyoke College. See Schifter (1995, vol. II, pp. 177-182) for a description of the specific writing assignments.

classroom in these small groups. People seemed to be able to connect to the short vignettes even though they were just one or two page accounts of student interactions (see Attachment A for an example of a vignette.)

Most sessions ended by teachers responding in writing to two or three reflective questions. One of the "exit card" questions for this session was to write "something about learning from hearing a story from somebody's classroom. Amy summarized their responses in a follow-up letter:

> The stories generated such a positive response that it seems important to make them a part of the inquiry group focus. One teacher mentioned that they held a mini-math lesson for her, another noted that the stories served as a visit to a colleague's class, one found the discussion with her colleagues about her own students to be a powerful experience. Another teacher mentioned that she couldn't wait to go home and read her collection of the inquiry group's stories! The small group in which I participated was exciting and full of potential as a math lesson, an opportunity to talk about practice and provided a window into the teachers' classrooms.

In the debrief of this session, Amy pondered explicitly and more seriously whether or not the focus agenda vehicle could help move the group to a different place of inquiry or whether they needed a different vehicle at this time. What seemed to happen in the small groups -- colleagues collaboratively working with each other on questions brought from their classrooms -- and what happened during the focus person session -- one teacher "instructing" the other teachers seemed miles apart.

She reflected on how she came to have a deeper connection to her work as a teacher and wondered if there was something fundamental about it or whether it was something that just happened to work for her. She reflected that

> My learning and own movement as a teacher was to have the children's work be that [focus] piece. So, my own background is to have the central piece be stories from people's classrooms, to be the children's mathematics, and to be the adult mathematics. That worked for me.

One of the apprentice facilitators noted that the sharing of the stories felt more stimulating than the large group discussion and that there was a lot in the "little vignettes" that they shared. As she noted, "It seemed like everyone owned what they had and they really wanted talk about it and they felt like they could talk about it."

From the spring of the inquiry group's first year through the fall of its second year, the vignette writing and sharing became an integral part of its structure. Amy recently summarized their effect on the group by writing to the teachers that

> "Vignettes came about as a way of bringing in voice, of honoring individual questions and ideas. They also provided opportunities for people to listen very carefully to what was going on in math class. To write one means to have listened carefully. To examine one together in a group means to consider the possibilities. Through the vignettes, we could see our teaching as well as our questions as well as hear the voices of our students.

The teachers came to see the writing of the vignettes as a piece of the work of the group. They decided in the fall of their second year that they would continue with the vignette structure. Their district had just selected a new progressive mathematics curriculum the previous June and they were all anxious about how they were going to teach using it. They adapted their vignette structure to write about a lesson they taught using the new curriculum. In their sharing, they would bring the lesson, do the mathematics themselves, and then look together at the vignette. Sometimes the teacher would actually read the vignette aloud.

This structure allowed the group to begin investigating the connections between the "intent" behind the particular lesson, their own intent in teaching it, and the ways in which the children were making sense of the mathematics in the lesson. In a sense, they were developing a new relationship to their children and to curriculum by carefully investigating how each related to the other.

By the end of the second fall, the group had evolved the vignette writing to a point where they could explore only one in a two-hour session, having started with sharing three to five vignettes in small groups. The teachers were finding the mathematics and the discussion so rich that the short sharing in small groups was not enough. Curiously, the vignette writing and sharing, which had started very small and unpressured had evolved over the course of a year to a place where it was very similar to the original focus person structure of one or two people bringing something from their classrooms to investigate collaboratively with their colleagues.[5]

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[5]This is a point that needs further investigation. What are the similarities and differences between the groups' more matured form of vignette sharing and the original focus person structure?

Recently, the group collaboratively decided to shift their structure to focus instead on preparing for teaching a lesson instead of writing about a lesson they had already taught. Currently, several teachers will bring in a lesson and work together with two or three other colleagues in examining the mathematical and pedagogical issues that arise for them in preparing to teach it. Often, they do the mathematics themselves, exploring the complexity of it — what children might find difficult in it and what they themselves might not understand. They have come to be quite intrigued with paying attention to what actually happens as they teach the lesson and comparing their own pre-assumptions of what children will or will not understand with what actually happens.

It would seem that the early experience in writing vignettes and learning to pay careful attention to what was happening in their classrooms contributed to building a base on which they could begin to look at their own teaching practice and, in fact, create a different practice.

What makes for a good beginning? -- Developing "Improvisational Perception"

What do we find if we step back to ask what we can learn from Amy's moves in restructuring the inquiry group and what they may tell us about how teachers come to have a considered, reflective practice as imagined in documents such as the NCTM Standards? Are Amy's moves to be understood as situational, reacting to the particulars of the moment and therefore not generalizable? As she herself pondered, was she just doing something that worked for her? Or can we find in these moves something more fundamental and principled that helps us to understand what it means to be, in Amy's words, "teachers of depth" who are indeed curious about and connected to their own classrooms and their own students' mathematical thinking.

This section argues that Amy's moves are indeed principled and calls upon the lens of practical judgment as articulated by philosopher Martha Nussbaum to tease out the principled basis of Amy's early work with her inquiry group.

Improvising in classrooms -- We begin with the idea that elementary mathematics teaching is fundamentally "improvisational," that in the conception of teaching embodied in reform

principles, teachers need to make choices in the moment about where to go and what to do next. This idea is starting to have more prominence in mathematics education reform and has an intuitive appeal as a description of what teachers have to be able to do in their classrooms.[6]

If we look back at the list of questions and concerns that the teachers raised in their first inquiry group session, we might say that the "best" answer to any number of them is, "It depends." Whether or not a teacher "tells" students something or lets them discover it on their own will depend on the circumstances and on what knowledge is at issue. How a teacher organizes the class into cooperative groups, and what will count as cooperative grouping, might depend on the particular students, what they already know, and how well they already can work together. How far one should take an activity and when to call it quits may depend, for instance on what the activity is, what path students took to it and what mathematical ideas are being explored. In short, what the "correct choice" is in any given moment depends on particulars of the situation and may call for teachers to improvise what they do.

It is important though, to recognize that there can be any number of conceptions of what it means to improvise. For example, to improvise may mean simply to "invent" something new, to engage in unplanned, ad hoc behavior. But, improvisation can mean engaging in principled, responsive moves that simultaneously respond to the moment and honor the tradition. We can see this especially in improvisational musical traditions where the improvisations move around a given structure. For example, jazz improvisation moves around a set of chord progressions while in baroque music, the improvisations entail the use of motifs or flourishes around a given melody line. Similarly, in teaching, improvising may mean calling upon a repertoire of moves to respond in the moment or following a path that feels true to the structure. This notion of improvising is indeed akin to Ball's (1993) idea when she writes about keeping her eye on the mathematical horizon as she listens to her students -- that improvisation involves reasoned principled moves that respect the knowledge of the discipline and the particular emerging history of the classroom and the students.

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[6]Both Heaton (1994) and Ball (1994), for example, describe their teaching moves as improvisational. As Ball notes, "Teachers often have to adapt and improvise in the face of what happens as lessons unfold" (1994, p.7).

Such potentially improvisational situations call not for prescriptions but good judgments. If teachers are going to be able to engage in the kind of responsive teaching envisioned in reform tenets then they will need to cultivate the knowledge and the skills to judge and improvise well in the moment. To assert this, however, is a complex claim. What does it mean, in fact, to have or to gain the knowledge and skills necessary to "improvise" in the moment and to know when it is appropriate to make what move? We can gain deeper insight into this improvisational judgment by turning to Nussbaum's account of practical reasoning (see Nussbaum, 1991). Using her formulation, we can examine the modifications and adaptations Amy made with the inquiry group in order to see them as situating the group to begin the work of developing an improvisational stance toward their classrooms.

Nussbaum's notion of practical judgment -- When Nussbaum writes about practical reasoning, her concern is with how we are able to choose well, especially in making moral choices. What is entailed in being able to make wise choices in the moment? What are the characteristics of "truly rational practical choice?" She draws from Aristotle to argue that the practical reasoning, or the "discernment of the correct choice", resides with something that he calls "perception." This perception is "some sort of complex responsiveness to the salient features of one's concrete situation" (Nussbaum, 1991, p. 55).

From this brief characterization, it is not difficult to see a parallel between this philosophical notion of practical judgment, defined as a complex responsiveness to salient features of the situation, and the practical accounts of teaching which highlight its complexity and situationally contingent nature. In both cases, the "perceiving agent" -- or the responsive teacher -- must pay careful attention to what is happening in order to be able to respond appropriately. Speaking of this responsiveness as improvisational, Nussbaum writes

> The salient difference between acting from a script and improvising is that one has to be not less but far *more* keenly attentive to what is given by the other actors and by the situation. You cannot get away with doing anything by rote. You must be actively aware and responsive at every moment, ready for surprises, so as not to let the others down. (p 94)

We might then argue that a critical component of teaching mathematics from a reformed perspective is cultivating this "improvisational perception" of the salient features of elementary mathematics teaching and learning. But to argue this would entail articulating what this "perception" is and what the "salient features" are that one would be required to perceive.

Dimensions of "Perception" -- In her analysis of Aristotle's notion of practical reasoning, Nussbaum focuses on three critical dimensions. First, she argues that the most difficult choices we face are often incommensurate, that they cannot be measured against each other on some general scale. In a teaching context, for example, a teacher may be faced with calling on a student whom she anticipates will have a mathematical insight that can lead the discussion into rich territory or calling on a student who generally never speaks. What she chooses in such a situation is not given by any rule and the "correct" or most appropriate decision will lie with the particulars of that situation: for example, where the class is in the discussion, what the teacher hopes to accomplish, and whether *at this time* it makes sense to call on one or the other, or what the teacher's sense is of how other students will respond to either student.

Secondly, Nussbaum argues that the particulars of the situation take precedent over universal rules or principles in making good judgments -- that "priority in practical choice should be accorded not to principle, but to perception, a faculty of discrimination that is concerned with apprehending concrete particulars" (p. 68). In other words, while we might be able to articulate general principles, rules, or conceptions -- for example, some general notion of "friend" -- it is only in the uniqueness of a particular friendship that the general is enacted and instantiated.

We can see this idea played out in Ball's (1993) depiction of her own practice. In that paper, she carefully describes the very particular dilemmas she faced as she taught her third-grade class both about negative numbers and explored the properties of odd and even numbers. In both cases she had to balance her commitment to the discipline of mathematics and to her students and where they were then. In writing about finding appropriate representations, she writes, " ... I must understand a lot about 9-year-olds: What will make sense to them? What will be interesting? How will they take hold of and transform different situations or models? I must consider the

mathematics in relation to the children and the children in relation to the mathematics" (1993, p. 394). Here, her general knowledge of the discipline of mathematics is mediated by her particular knowledge of her 9-year-old students.

And thirdly, Nussbaum argues for emotion and imagination as essential components of practical knowing. For her, the emotions are not just a means to getting to the right intellectual view of the situation but rather "they are themselves modes of knowing." As she writes, "Good perception is a full recognition or acknowledgment of the nature of the practical situation" (p. 79) and this involves both appropriate intellectual and *emotional* recognition. She writes that

> ... we might say that a person of practical insight will cultivate emotional openness and responsiveness in approaching a new situation. Frequently, it will be her passional response, rather than detached thinking, that will guide her to the appropriate recognitions (p. 78-79).

Taking these three dimensions together, Nussbaum portrays an image of practical knowing that is highly disciplined, discerning of salient features of the particular situation, and emotionally aware and connected to the situation's unique features. She describes the person of practical wisdom as such:

> Being responsibly committed to the world of value before her, the perceiving agent can be counted on to investigate and scrutinize the nature of each item and each situation, to respond to what is there before her with full sensitivity and imaginative vigor, not to fall short of what is there to be seen and felt because of evasiveness, scientific abstractness, or a love of simplification. [She] is a person whom we could trust to describe a complex situation with full concreteness of detail and emotional shading, missing nothing of practical relevance.

Amy's work from the perspective of practical knowing -- Does this brief foray into Nussbaum's complex portrayal of practical reasoning provide us insight into Amy's work with her inquiry group? If we accept that reformed teaching requires improvisation and we use Nussbaum's notion of practical reasoning to articulate some of what an improvisational stance to one's teaching practice would be, then perhaps we can. Specifically we can argue that Amy effectively reshaped her inquiry group so that teachers could cultivate and refine that stance toward their own practice. We can look again at the things she did with the group to see this more clearly.

Slowing the pace down -- It was Amy's sense that at least some of the teachers were feeling especially overwhelmed by how much they felt they had to change their teaching practice

from what they had been doing. The summer had been an intense experience, leaving some of them no longer confident with their own teaching and feeling as if they were searching for how to teach the "EDC way."[7] In the move to have teachers begin to write vignettes, Amy essentially slowed down the pace and reduced the anxiety of the work.

The writing assignment itself and the sharing of the vignettes in small groups helped to refocus the group's attention away from agonizing about what they should be doing to looking at what already was there in their classrooms. This kind of work -- to be writing about what their students say or do -- did not call upon them to be responsible yet for giving an account of a dilemma of judgment with which they might be faced.

If we accept that reformed teaching requires a refined and disciplined perception of the particulars, then a way to start is to slow things down to look at and listen to what is given in the particular moment. As Ball (1993, p. 374) writes, "The things that children wonder about, think, and invent are deep and tough. Learning to hear them is, I think, at the heart of being a teacher." This doesn't necessarily call for teachers to be making changes immediately in their own teaching practice for they need time to develop their own discernment and critical eye.

Writing as the cultivation of disciplined perception -- We need also to consider the form or the structure that Amy chose to use. Writing is not always a medium with which teachers are comfortable and indeed some teachers find it difficult and challenging. But there is something in the narrative or storied form that holds the particulars still long enough to allow for their careful examination.

The writing assignment was simple enough, asking teachers to write a description of a time when they knew a child understood something or a time when a child or a class surprised them. But it focused their attention on the classroom events and the children's own thinking. By having to write a short snippet about what a student said or what surprising happened during a particular class, the teachers were beginning to know how to look and where to look in their classrooms for the grounds on which their judgments would be made.

[7]The project was based at Education Development Center in Newton, MA.

Emotional Awareness — Nussbaum's characterization of practical knowing calls for an emotional awareness of and connection to the particulars of the situation. By asking teachers to write carefully and respectfully about what *their own students* were saying and doing, Amy was helping them to make that connection. The connection to the mathematical ideas and to the ways that children makes sense of these ideas was made through connecting to particular students and the ways that *they* made sense of the mathematical ideas.

Recognizing salient features of mathematics teaching — Developing a discerning eye or an ear begs the questions, "To what does one actually pays attention?" If one is to develop an ability to recognize the salient features of this situation in order to make wise judgments about what to do, what counts as salient features in the teaching of elementary mathematics? In the case of writing the vignettes, the teachers were asked to pay attention to what the students said. Here, the salient feature was children's mathematical thinking as expressed primarily through their talk. Teachers were especially encouraged to capture as much dialogue as possible.

Cultivating curiosity about the children's work and their mathematics — Another of the critical features of reformed mathematics teaching is recognizing and being curious about the complexity underlying the deceptively simple elementary curriculum. That there *is* something to be curious about — about the ways that children make sense of the mathematics or about the mathematics itself — may be a new insight for many teachers and something in fact to cultivate. For example, in the vignette attached where the teacher wrote about students adding 38 + 45, that there is anything to be curious about in the two different conceptions of "carrying the one" may be new to her. What indeed is similar or different from a child saying that when you add 8 + 5, because you don't have any space to write the 13, you have to put it somewhere and another child saying that the one you carry is one 10 that you traded 10 of your 13 ones for?

Practicing "being there" in contrast to "getting through" — In these short vignettes, the teachers were not asked to focus on their own moves or choices. In contrast to the early focus person sessions where teachers brought "data" about what they did -- how they did assessment, how they asked a question -- the vignettes focused only on being in the moment with what children

did or said. Here, the teachers were in essence practicing "being there" in the space where students' ideas were unfolding and taking shape.

If we draw an analogy back to improvisational music, we can consider a parallel here between this kind of "practicing" and the kind of practicing in which an improvisational musician might engage. For example, in a conversation with an improvisational musician, one of the authors asked him to describe what it was like to practice for a performance with other musicians, given that he could never really practice exactly what he and others would later perform. For him, practice entailed entering into a musical territory to become familiar with it and to come to know it. If then, in the performance, another musician took the music into that space, he would be prepared because he was familiar with it and would know it. In a similar way, the writing and the sharing of the vignettes allowed the teachers to practice listening to students, uncovering what was significant about their thinking, and coming to gain a sense of what they can expect in the classroom.

Conclusion — Questions and directions for further research

Trying to understand the development of Amy's inquiry group and her judgments and choices of what was needed to move the group into a space of inquiry has often felt like entering a hall of mirrors. The work of creating that space of inquiry has itself required Amy to be attentive to the situation, perceptive of where the teachers are in their own learning, and emotionally aware of their connection to the group and to each other — indeed, it has required Amy to improvise. She herself has had to be the "perceiving agent," with her own eye toward some intellectual horizon while listening carefully to and paying attention to the teachers in her own group. While we can look at the move to have teachers write vignettes as a means into an "improvisational space," we are still left with more questions than we have answered. Here we will mention three areas that call for sensitive, critical, analysis.

First, if we accept that the ability to improvise in mathematics teaching — or any "reformed" teaching — rests on a complex responsiveness to or perception of salient features, we

need to explore more carefully what the salient features are. What the "salient features" are in teaching mathematics may differ from what they are in history or science. While we might notice a similarity here to the idea of "pedagogical content knowledge", there seems to be something fundamentally different, particularly in the ability to *recognize* the salient features in context.

Secondly, if we conclude here that the writing of the vignettes served as a particular means in to developing this perception and discernment, we need to ask what it is about the writing that allows that to happen. Is writing the only medium for this? The "best" medium? Are there other structures that could work to help teachers develop the careful, disciplined looking, listening, and attentiveness they need to be able to improvise in their classrooms? On what grounds are we to judge them?

And thirdly, what is the role of the facilitator in helping teachers to refine and cultivate this improvisational perception? What kinds of skills and competencies do facilitators of teacher groups need to have and how are they to develop them? It seems clear in observing Amy's work that she brought with her a disciplined sensitivity to the particulars of this inquiry group and a responsible commitment to an ideal of what she knew teaching mathematics could be. And she made judgments along the way that respected both.

Providing professional development for teachers is a complex proposition. While we certainly can say that teachers will need to do more than cultivate a sensitive and respectful perception (in the more philosophical sense) of their mathematics classrooms to teach commensurate with reform principles , we argue that this perception is a critical piece of being able to teach wisely. How teachers come to have this perception and what the appropriate structures are for developing it are crucial questions we need to address if we hope to help teachers become "teachers of depth."

Attachment A -- Vignette Sample

$$\begin{array}{r} 38 \\ +45 \\ \hline 83 \end{array}$$

We had been working on place value as well as addition. Students had played the game chip trading.

I asked a student to add 2 two-digit numbers that involved regrouping. She solved the problem correctly, so I asked her to explain her thinking when she solved it. She began by saying, "I started in the one's and I put the three down, I carried the one and 1 + 3 + 4 equals 8 so I got 83."

I asked the class if anyone wanted to add on or paraphrase what she had said. One boy said, "Yeah, I know what she's saying. She said that you add the numbers up first, and 8 +5 equals 13. You don't have any space to write the 13 so you have to put it somewhere ..." He was quickly interrupted by the first student that spoke. She said, "That is NOT what I was saying, I was saying that it was like chip trading. I had thirteen ones, so I traded ten to the next column for ONE ten. That's why I put the one in the tens place!"

It seemed clear to me from this discourse that she was definite about why she was carrying that "one". I'm not so sure about him. I found it very interesting how carefully she listened to his paraphrase and how clearly she understood what she had done.

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What makes for a good beginning?
Improvising in an Elementary Mathematics Teacher Inquiry Group

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Paper presented at the annual meetings of the American Educational Research Association, Chicago, March 24, 1997. Support for the research and preparation of this paper was provided by NSF Grant No. ESI-9254479. The authors would like to thank Deborah Schifter for her helpful comments and suggestions.

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Preface

For the last year and a half, one of the authors of this paper, Amy Morse, has facilitated a teacher inquiry group as part of a multi-year NSF-funded elementary mathematics teacher enhancement project. The other two, Lynn Goldsmith and Annette Sassi, have been researchers on the project, seeking to understand more deeply the nature of these inquiry groups and the work entailed for already practicing teachers to become more reflective and effective teachers of mathematics. This paper represents the thinking of all three of us. We have spent numerous hours discussing the development of Amy's group and the assumptions that underlie the moves she made as she came to make sense for herself what the work of this group was and could be. The paper is written through the interpretive lens of Annette, who framed the initial exploration, invited Amy and Lynn to engage in the dialogue, and took the responsibility for writing up the paper. It is a much smaller piece of investigation than initially proposed because, the more we discussed the issues, the more we realized that so much of the essence of the group resided in those early decisions and moves. By asking and attempting to answer the question, what makes for a good beginning, we found we had to look deeply at the assumptions, purposes, and goals of inquiry groups in general and their connection to the practice of teaching.

Introduction

The teaching of elementary mathematics has, within the last decade, undergone a tremendous amount of scrutiny and redefinition. Informed in part by constructivist theories of learning (see, for example von Glaserfeld, 1984, 1990; Cobb et al., 1991, 1992; Goldsmith & Schifter, 1994), teachers, researchers and teacher educators alike have set out to transform the practice of teaching

mathematics (see, for example, Schifter 1995; Schifter & Fosnot, 1993). There is some general sense that the practices of mathematics teaching and the mathematical knowledge necessary to engage in a reflective, principled, and student-informed teaching practice must be very different from that which many teachers often have. Furthermore, because this kind of teaching is not rule-governed and the decisions teachers must make cannot be prescribed, teachers must develop a keen sense of judgment to be ready to improvise in their classrooms (Sassi & Goldsmith, 1996).

Yet, there is also some understanding that teachers cannot take on this work in isolation. What teachers face in developing their practice is challenging and calls for supportive collaborative experiences in which they can take on this challenge with other colleagues. Teacher inquiry groups, where teachers can meet regularly to investigate issues in the teaching and learning of mathematics, are now becoming more prevalent . Questions remain, however, about how such groups can support this work and what structures or designs work best.

The paper begins with an overview of the Mathematics for Tomorrow Project and the teacher inquiry groups that are part of it. It next describes the development of one inquiry group within the project and the crafting of a structure that was workable for it. It then analyzes the choices and resulting characteristics of the group as a case of developing the practical judgment and "improvisational perception" necessary for the kind responsive teaching envisioned in reform efforts. It concludes with a consideration of several areas for further research that arise through this analysis.

The Mathematics for Tomorrow Project and Teacher Inquiry Groups

The Mathematics for Tomorrow (MFT) project is a multi-year systemically-embedded teacher enhancement project supported by the National Science Foundation. The project is based on the assumption that the kinds of changes called for in instructional practices require teachers to "examine long-standing beliefs about the nature of knowledge and learning, deepen their knowledge of the subject they teach, and reinvent their classroom practice from within a new conceptual frame." While teachers will still need to consider new teaching techniques and tools,

such as manipulatives, cooperative groups, and new questioning strategies , such techniques and tools must rest on a new understanding of the relationship between teaching and learning.

A central component in the design of the MFT project are school-based inquiry groups. As originally proposed, teachers were to meet bi-weekly in school-based groups to "engage in ongoing inquiry about their mathematics classes; develop new ideas about mathematics, learning, and teaching; and work collaboratively with supervisors, project staff, and each other to make changes in their classroom practice consistent with these new ideas." Meetings would focus on discussions and interpretation of data that teachers would bring from their classrooms. Such data could include student work, lesson plans with observations of what actually happened, journal entries, and "case studies" of individual students.

The form or structure of these groups would or could take was left open-ended. They were to be run as "communities of inquiry" where the inquiry would be into one's own practice of teaching mathematics. Structures were to evolve through the life of the group to meet the needs of participants.

The challenge of starting a new inquiry group

Amy Morse joined the MFT project as it began its third year. MFT had just finished its first two-year cycle and was starting its second and last two-year cycle with a new cohort of teachers. Amy would take responsibility for facilitating an inquiry group based in a mid-sized, middle income district in the greater Boston area. She had come to the project with ten years experience as an elementary school teacher as well as a history of experiences in a range of professional development projects.[1] Although she had had many experiences working with

[1]Amy credits several key teacher development projects in which she participated for significantly shaping her development as a teacher. She participated in the Boston Writing Project where she began to rediscover writing -- and the sharing of one's writing -- as a valuable means toward reflective learning. She also was a participant in "Talking Mathematics," co-directed by Susan Jo Russell and Becky Corwin of TERC. The purpose of this project was to help teachers learn how to engage in mathematics dialogue with the idea that teachers will need to know how to do this if they are to be able to engage students in it. Amy found this project to provide an opportunity to recapture her intrigue with and love of mathematics. Prior to and continuing while being a teacher educator on MFT, Amy participated in "Teaching to the Big Ideas" (TBI), co-directed by Deborah Schifter, Susan Jo Russell, and Virginia Bastable. This project has also made writing central to the exploration of children's mathematical thinking and the complexities inherent in the elementary mathematics curriculum. Amy had the unique opportunity to be

teachers as colleagues, the MFT project was her first experience working with teachers as a teacher educator.

The group was made up of nine teachers new to the MFT project as well as two teachers from the first cohort continuing on as "apprentice facilitators." These nine teachers had just participated in their first two week summer institute in which they explored a number of mathematical issues including place value and proportion, issues about how children learn and know mathematics, and issues pertaining to their own instructional practice including cooperative learning, classroom assessment, and classroom management.

The Inquiry Group Design -- The general inquiry groups structure, which was designed by the two other teacher educators on the project and Amy at the beginning of the new cycle, grew out of the previous two-year cycle and had two aspects to it. On certain weeks, two teachers would be the designated "focus" team and would bring in some questions about their mathematics teaching practice that were "dilemma filled"[2] and classroom data to support a collaborative investigation of the questions. In preparation for this session, they would visit each others' classrooms as a way of helping each other investigate the questions they had mutually decided to explore. Interspersed among these sessions would be ones with a mathematical "focus" where the facilitator would bring in mathematics for the group to do together.

Starting off -- At the first session, the group brainstormed questions or dilemmas that could form the basis of focus topics. Most of the questions were ones the teachers had about their own moves in the classroom as they were trying to figure out what this "new kind of teaching" was all about. Below are some of the questions they raised in their discussion:[3]

If you're in to an activity, when do you call it quits and should get on to the next thing?

> How do I relate these "projects" [e.g. an activity like "tangrams"] to the standard math curriculum. What is the bridge?

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concomitantly a teacher educator in one project and a teacher/participant in another and was able to use one to inform the other in her own developing practice.

[2]This structure was based significantly on the work of teacher researchers who studied their own teaching practice. See, for example Ball (1993) and Lampert (1989). Both researchers have contributed to the idea that teaching inherently is about making difficult choices in the moment.

[3]These questions are the actual words used by the teachers and transcribed from the audiotape of the session. Some slight modifications were made, noted by the brackets, for clarification purposes.

> If I focus [on] using math logs and this whole process, what happens to the children next year [in] the next class if the focus is more traditional and the focus is based on skills.
>
> When [do I] stop the project and how I know that it has been understood by all. Do I just give a test at the end of this. Is there another assessment I can give, other than math journals? Is this the correct place to finish. I honestly don't know sometimes, have I gone too much on the subject and am I lacking something? Or have I not gone enough and do I have to continue on this?
>
> How do you get [students] into cooperative group work when [they] just don't want to work .. they just are too distracted by all the kids talking and working?
>
> How [do I] facilitate [both] computation skills and concept mastery with the exploration and discovery method and when and how [do I] incorporate direct instruction and how [do I] make evaluation?

Even as the teachers shared the questions that were most pressing on their minds about how to "do" this new kind of teaching, Amy was cautious about how much they should take on all at once. In a letter to them after this first session, she wrote, "I have been thinking about our Inquiry Group and want to explore here some of the foundations of the work we can do together. I also think there were enough issues raised during the first meeting concerning the complexities of teaching with new perspectives that it will be important for us to take our time, to insist that the session be useful and about learning, and to find ways to examine our work critically with an eye toward seeing new possibilities and not faults."

Beginning to feel "on the wrong track" -- Even with the first focus session, in which the two apprentice facilitators were the focus people, Amy began to wonder if this "structure" would allow the group to go where she hoped (and knew from experience) that they could go. The two teachers had put a lot of work into preparing a session on investigating the nature of questioning and exploring what makes for a good question. They had both brought data from their classrooms, made transcripts, and brought the mathematics for the group to do together.

Yet, as Amy noted in her reflections on the field notes, there were "many times the conversation dies." She noted that the topic "feels like a terribly unwieldy topic for teachers new to this point of view or frame of mind." There was something missing in the ways the group talked about questions, staying superficial and not being able to get specific.

Sensing that people might not connect to the focus topic without bringing something of their own, Amy modified the structure for the next focus session in which two new teachers would be bringing in data to support an investigation into the mathematical talk that could go on in a classroom. She asked the teachers to write a short account about something that happened in their classroom.[4] As she wrote to them,

> To support that investigation, the assignment for everyone in the Inquiry Group is to write up an episode, a vignette or a story of talk that went on in her own classroom. A description which, in part, includes the mathematical topic, the grade level and any other interesting and orienting information will be helpful. Describe to the reader what actually took place in your classroom. The writing assignment is to describe a time when you knew a child understood something you were teaching or a time when a child or a class surprised you. That surprise could come when you suddenly realize that you had assumed all along the children understood something and here was new evidence that they did not. Or surprise could come in the form of learning some new way of looking at a piece of mathematics that you had never considered yourself. This new way of seeing something may lead you to new ideas about the way your student or students think about or understand this topic.
>
> You might consider ending the story with your questions to the reader about what your next moves might be or by simply taking the reader to specific points and asking out loud, "What's going on here?" It is useful to be as specific as possible and include as much actual dialogue as you can record with some degree of accuracy. Feel free to attach other evidence of the children's thinking if it is available; a journal entry or drawings.

All but three non-focus teachers wrote vignettes or stories to complement the focus topic. A critical turning point came two inquiry groups later when Amy decided to have the group spend about half the session in small groups discussing their vignettes after the focus pair had presented their work.

The focus topic for the session was assessment. This session ended up being especially presentation-like where one of the focus teachers described the variety of assessment strategies she used. One of the apprentice facilitators described the session as similar to being at a graduate school presentation. The other was left feeling that the one focus teacher had come to the group with the intention of "instructing."

In contrast, the small group sharing of vignettes had a very different feel to it. People who were often quiet during the focus person sessions actually talked and shared stories from their own

[4]This writing assignment was adapted from the writing assignments used in the Mathematics Process Writing Project, conducted by SummerMath for Teachers at Mount Holyoke College. See Schifter (1995, vol. II, pp. 177-182) for a description of the specific writing assignments.

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classroom in these small groups. People seemed to be able to connect to the short vignettes even though they were just one or two page accounts of student interactions (see Attachment A for an example of a vignette.)

Most sessions ended by teachers responding in writing to two or three reflective questions. One of the "exit card" questions for this session was to write "something about learning from hearing a story from somebody's classroom. Amy summarized their responses in a follow-up letter:

> The stories generated such a positive response that it seems important to make them a part of the inquiry group focus. One teacher mentioned that they held a mini-math lesson for her, another noted that the stories served as a visit to a colleague's class, one found the discussion with her colleagues about her own students to be a powerful experience. Another teacher mentioned that she couldn't wait to go home and read her collection of the inquiry group's stories! The small group in which I participated was exciting and full of potential as a math lesson, an opportunity to talk about practice and provided a window into the teachers' classrooms.

In the debrief of this session, Amy pondered explicitly and more seriously whether or not the focus agenda vehicle could help move the group to a different place of inquiry or whether they needed a different vehicle at this time. What seemed to happen in the small groups -- colleagues collaboratively working with each other on questions brought from their classrooms -- and what happened during the focus person session -- one teacher "instructing" the other teachers seemed miles apart.

She reflected on how she came to have a deeper connection to her work as a teacher and wondered if there was something fundamental about it or whether it was something that just happened to work for her. She reflected that

> My learning and own movement as a teacher was to have the children's work be that [focus] piece. So, my own background is to have the central piece be stories from people's classrooms, to be the children's mathematics, and to be the adult mathematics. That worked for me.

One of the apprentice facilitators noted that the sharing of the stories felt more stimulating than the large group discussion and that there was a lot in the "little vignettes" that they shared. As she noted, "It seemed like everyone owned what they had and they really wanted talk about it and they felt like they could talk about it."

From the spring of the inquiry group's first year through the fall of its second year, the vignette writing and sharing became an integral part of its structure. Amy recently summarized their effect on the group by writing to the teachers that

> "Vignettes came about as a way of bringing in voice, of honoring individual questions and ideas. They also provided opportunities for people to listen very carefully to what was going on in math class. To write one means to have listened carefully. To examine one together in a group means to consider the possibilities. Through the vignettes, we could see our teaching as well as our questions as well as hear the voices of our students.

The teachers came to see the writing of the vignettes as a piece of the work of the group. They decided in the fall of their second year that they would continue with the vignette structure. Their district had just selected a new progressive mathematics curriculum the previous June and they were all anxious about how they were going to teach using it. They adapted their vignette structure to write about a lesson they taught using the new curriculum. In their sharing, they would bring the lesson, do the mathematics themselves, and then look together at the vignette. Sometimes the teacher would actually read the vignette aloud.

This structure allowed the group to begin investigating the connections between the "intent" behind the particular lesson, their own intent in teaching it, and the ways in which the children were making sense of the mathematics in the lesson. In a sense, they were developing a new relationship to their children and to curriculum by carefully investigating how each related to the other.

By the end of the second fall, the group had evolved the vignette writing to a point where they could explore only one in a two-hour session, having started with sharing three to five vignettes in small groups. The teachers were finding the mathematics and the discussion so rich that the short sharing in small groups was not enough. Curiously, the vignette writing and sharing, which had started very small and unpressured had evolved over the course of a year to a place where it was very similar to the original focus person structure of one or two people bringing something from their classrooms to investigate collaboratively with their colleagues.[5]

[5]This is a point that needs further investigation. What are the similarities and differences between the groups' more matured form of vignette sharing and the original focus person structure?

Recently, the group collaboratively decided to shift their structure to focus instead on preparing for teaching a lesson instead of writing about a lesson they had already taught. Currently, several teachers will bring in a lesson and work together with two or three other colleagues in examining the mathematical and pedagogical issues that arise for them in preparing to teach it. Often, they do the mathematics themselves, exploring the complexity of it — what children might find difficult in it and what they themselves might not understand. They have come to be quite intrigued with paying attention to what actually happens as they teach the lesson and comparing their own pre-assumptions of what children will or will not understand with what actually happens.

It would seem that the early experience in writing vignettes and learning to pay careful attention to what was happening in their classrooms contributed to building a base on which they could begin to look at their own teaching practice and, in fact, create a different practice.

What makes for a good beginning? -- Developing "Improvisational Perception"

What do we find if we step back to ask what we can learn from Amy's moves in restructuring the inquiry group and what they may tell us about how teachers come to have a considered, reflective practice as imagined in documents such as the NCTM Standards? Are Amy's moves to be understood as situational, reacting to the particulars of the moment and therefore not generalizable? As she herself pondered, was she just doing something that worked for her? Or can we find in these moves something more fundamental and principled that helps us to understand what it means to be, in Amy's words, "teachers of depth" who are indeed curious about and connected to their own classrooms and their own students' mathematical thinking.

This section argues that Amy's moves are indeed principled and calls upon the lens of practical judgment as articulated by philosopher Martha Nussbaum to tease out the principled basis of Amy's early work with her inquiry group.

Improvising in classrooms -- We begin with the idea that elementary mathematics teaching is fundamentally "improvisational," that in the conception of teaching embodied in reform

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principles, teachers need to make choices in the moment about where to go and what to do next. This idea is starting to have more prominence in mathematics education reform and has an intuitive appeal as a description of what teachers have to be able to do in their classrooms.[6]

If we look back at the list of questions and concerns that the teachers raised in their first inquiry group session, we might say that the "best" answer to any number of them is, "It depends." Whether or not a teacher "tells" students something or lets them discover it on their own will depend on the circumstances and on what knowledge is at issue. How a teacher organizes the class into cooperative groups, and what will count as cooperative grouping, might depend on the particular students, what they already know, and how well they already can work together. How far one should take an activity and when to call it quits may depend, for instance on what the activity is, what path students took to it and what mathematical ideas are being explored. In short, what the "correct choice" is in any given moment depends on particulars of the situation and may call for teachers to improvise what they do.

It is important though, to recognize that there can be any number of conceptions of what it means to improvise. For example, to improvise may mean simply to "invent" something new, to engage in unplanned, ad hoc behavior. But, improvisation can mean engaging in principled, responsive moves that simultaneously respond to the moment and honor the tradition. We can see this especially in improvisational musical traditions where the improvisations move around a given structure. For example, jazz improvisation moves around a set of chord progressions while in baroque music, the improvisations entail the use of motifs or flourishes around a given melody line. Similarly, in teaching, improvising may mean calling upon a repertoire of moves to respond in the moment or following a path that feels true to the structure. This notion of improvising is indeed akin to Ball's (1993) idea when she writes about keeping her eye on the mathematical horizon as she listens to her students -- that improvisation involves reasoned principled moves that respect the knowledge of the discipline and the particular emerging history of the classroom and the students.

[6]Both Heaton (1994) and Ball (1994), for example, describe their teaching moves as improvisational. As Ball notes, "Teachers often have to adapt and improvise in the face of what happens as lessons unfold" (1994, p.7).

Such potentially improvisational situations call not for prescriptions but good judgments. If teachers are going to be able to engage in the kind of responsive teaching envisioned in reform tenets then they will need to cultivate the knowledge and the skills to judge and improvise well in the moment. To assert this, however, is a complex claim. What does it mean, in fact, to have or to gain the knowledge and skills necessary to "improvise" in the moment and to know when it is appropriate to make what move? We can gain deeper insight into this improvisational judgment by turning to Nussbaum's account of practical reasoning (see Nussbaum, 1991). Using her formulation, we can examine the modifications and adaptations Amy made with the inquiry group in order to see them as situating the group to begin the work of developing an improvisational stance toward their classrooms.

Nussbaum's notion of practical judgment -- When Nussbaum writes about practical reasoning, her concern is with how we are able to choose well, especially in making moral choices. What is entailed in being able to make wise choices in the moment? What are the characteristics of "truly rational practical choice?" She draws from Aristotle to argue that the practical reasoning, or the "discernment of the correct choice", resides with something that he calls "perception." This perception is "some sort of complex responsiveness to the salient features of one's concrete situation" (Nussbaum, 1991, p. 55).

From this brief characterization, it is not difficult to see a parallel between this philosophical notion of practical judgment, defined as a complex responsiveness to salient features of the situation, and the practical accounts of teaching which highlight its complexity and situationally contingent nature. In both cases, the "perceiving agent" -- or the responsive teacher -- must pay careful attention to what is happening in order to be able to respond appropriately. Speaking of this responsiveness as improvisational, Nussbaum writes

> The salient difference between acting from a script and improvising is that one has to be not less but far *more* keenly attentive to what is given by the other actors and by the situation. You cannot get away with doing anything by rote. You must be actively aware and responsive at every moment, ready for surprises, so as not to let the others down. (p 94)

We might then argue that a critical component of teaching mathematics from a reformed perspective is cultivating this "improvisational perception" of the salient features of elementary mathematics teaching and learning. But to argue this would entail articulating what this "perception" is and what the "salient features" are that one would be required to perceive.

Dimensions of "Perception" -- In her analysis of Aristotle's notion of practical reasoning, Nussbaum focuses on three critical dimensions. First, she argues that the most difficult choices we face are often incommensurate, that they cannot be measured against each other on some general scale. In a teaching context, for example, a teacher may be faced with calling on a student whom she anticipates will have a mathematical insight that can lead the discussion into rich territory or calling on a student who generally never speaks. What she chooses in such a situation is not given by any rule and the "correct" or most appropriate decision will lie with the particulars of that situation: for example, where the class is in the discussion, what the teacher hopes to accomplish, and whether *at this time* it makes sense to call on one or the other, or what the teacher's sense is of how other students will respond to either student.

Secondly, Nussbaum argues that the particulars of the situation take precedent over universal rules or principles in making good judgments -- that "priority in practical choice should be accorded not to principle, but to perception, a faculty of discrimination that is concerned with apprehending concrete particulars" (p. 68). In other words, while we might be able to articulate general principles, rules, or conceptions -- for example, some general notion of "friend" -- it is only in the uniqueness of a particular friendship that the general is enacted and instantiated.

We can see this idea played out in Ball's (1993) depiction of her own practice. In that paper, she carefully describes the very particular dilemmas she faced as she taught her third-grade class both about negative numbers and explored the properties of odd and even numbers. In both cases she had to balance her commitment to the discipline of mathematics and to her students and where they were then. In writing about finding appropriate representations, she writes, " ... I must understand a lot about 9-year-olds: What will make sense to them? What will be interesting? How will they take hold of and transform different situations or models? I must consider the

mathematics in relation to the children and the children in relation to the mathematics" (1993, p. 394). Here, her general knowledge of the discipline of mathematics is mediated by her particular knowledge of her 9-year-old students.

And thirdly, Nussbaum argues for emotion and imagination as essential components of practical knowing. For her, the emotions are not just a means to getting to the right intellectual view of the situation but rather "they are themselves modes of knowing." As she writes, "Good perception is a full recognition or acknowledgment of the nature of the practical situation" (p. 79) and this involves both appropriate intellectual and *emotional* recognition. She writes that

> ... we might say that a person of practical insight will cultivate emotional openness and responsiveness in approaching a new situation. Frequently, it will be her passional response, rather than detached thinking, that will guide her to the appropriate recognitions (p. 78-79).

Taking these three dimensions together, Nussbaum portrays an image of practical knowing that is highly disciplined, discerning of salient features of the particular situation, and emotionally aware and connected to the situation's unique features. She describes the person of practical wisdom as such:

> Being responsibly committed to the world of value before her, the perceiving agent can be counted on to investigate and scrutinize the nature of each item and each situation, to respond to what is there before her with full sensitivity and imaginative vigor, not to fall short of what is there to be seen and felt because of evasiveness, scientific abstractness, or a love of simplification. [She] is a person whom we could trust to describe a complex situation with full concreteness of detail and emotional shading, missing nothing of practical relevance.

Amy's work from the perspective of practical knowing -- Does this brief foray into Nussbaum's complex portrayal of practical reasoning provide us insight into Amy's work with her inquiry group? If we accept that reformed teaching requires improvisation and we use Nussbaum's notion of practical reasoning to articulate some of what an improvisational stance to one's teaching practice would be, then perhaps we can. Specifically we can argue that Amy effectively reshaped her inquiry group so that teachers could cultivate and refine that stance toward their own practice. We can look again at the things she did with the group to see this more clearly.

Slowing the pace down -- It was Amy's sense that at least some of the teachers were feeling especially overwhelmed by how much they felt they had to change their teaching practice

from what they had been doing. The summer had been an intense experience, leaving some of them no longer confident with their own teaching and feeling as if they were searching for how to teach the "EDC way."[7] In the move to have teachers begin to write vignettes, Amy essentially slowed down the pace and reduced the anxiety of the work.

The writing assignment itself and the sharing of the vignettes in small groups helped to refocus the group's attention away from agonizing about what they should be doing to looking at what already was there in their classrooms. This kind of work -- to be writing about what their students say or do -- did not call upon them to be responsible yet for giving an account of a dilemma of judgment with which they might be faced.

If we accept that reformed teaching requires a refined and disciplined perception of the particulars, then a way to start is to slow things down to look at and listen to what is given in the particular moment. As Ball (1993, p. 374) writes, "The things that children wonder about, think, and invent are deep and tough. Learning to hear them is, I think, at the heart of being a teacher." This doesn't necessarily call for teachers to be making changes immediately in their own teaching practice for they need time to develop their own discernment and critical eye.

Writing as the cultivation of disciplined perception -- We need also to consider the form or the structure that Amy chose to use. Writing is not always a medium with which teachers are comfortable and indeed some teachers find it difficult and challenging. But there is something in the narrative or storied form that holds the particulars still long enough to allow for their careful examination.

The writing assignment was simple enough, asking teachers to write a description of a time when they knew a child understood something or a time when a child or a class surprised them. But it focused their attention on the classroom events and the children's own thinking. By having to write a short snippet about what a student said or what surprising happened during a particular class, the teachers were beginning to know how to look and where to look in their classrooms for the grounds on which their judgments would be made.

[7]The project was based at Education Development Center in Newton, MA.

Emotional Awareness — Nussbaum's characterization of practical knowing calls for an emotional awareness of and connection to the particulars of the situation. By asking teachers to write carefully and respectfully about what *their own students* were saying and doing, Amy was helping them to make that connection. The connection to the mathematical ideas and to the ways that children makes sense of these ideas was made through connecting to particular students and the ways that *they* made sense of the mathematical ideas.

Recognizing salient features of mathematics teaching — Developing a discerning eye or an ear begs the questions, "To what does one actually pays attention?" If one is to develop an ability to recognize the salient features of this situation in order to make wise judgments about what to do, what counts as salient features in the teaching of elementary mathematics? In the case of writing the vignettes, the teachers were asked to pay attention to what the students said. Here, the salient feature was children's mathematical thinking as expressed primarily through their talk. Teachers were especially encouraged to capture as much dialogue as possible.

Cultivating curiosity about the children's work and their mathematics — Another of the critical features of reformed mathematics teaching is recognizing and being curious about the complexity underlying the deceptively simple elementary curriculum. That there *is* something to be curious about — about the ways that children make sense of the mathematics or about the mathematics itself — may be a new insight for many teachers and something in fact to cultivate. For example, in the vignette attached where the teacher wrote about students adding 38 + 45, that there is anything to be curious about in the two different conceptions of "carrying the one" may be new to her. What indeed is similar or different from a child saying that when you add 8 + 5, because you don't have any space to write the 13, you have to put it somewhere and another child saying that the one you carry is one 10 that you traded 10 of your 13 ones for?

Practicing "being there" in contrast to "getting through" — In these short vignettes, the teachers were not asked to focus on their own moves or choices. In contrast to the early focus person sessions where teachers brought "data" about what they did -- how they did assessment, how they asked a question -- the vignettes focused only on being in the moment with what children

did or said. Here, the teachers were in essence practicing "being there" in the space where students' ideas were unfolding and taking shape.

If we draw an analogy back to improvisational music, we can consider a parallel here between this kind of "practicing" and the kind of practicing in which an improvisational musician might engage. For example, in a conversation with an improvisational musician, one of the authors asked him to describe what it was like to practice for a performance with other musicians, given that he could never really practice exactly what he and others would later perform. For him, practice entailed entering into a musical territory to become familiar with it and to come to know it. If then, in the performance, another musician took the music into that space, he would be prepared because he was familiar with it and would know it. In a similar way, the writing and the sharing of the vignettes allowed the teachers to practice listening to students, uncovering what was significant about their thinking, and coming to gain a sense of what they can expect in the classroom.

Conclusion — Questions and directions for further research

Trying to understand the development of Amy's inquiry group and her judgments and choices of what was needed to move the group into a space of inquiry has often felt like entering a hall of mirrors. The work of creating that space of inquiry has itself required Amy to be attentive to the situation, perceptive of where the teachers are in their own learning, and emotionally aware of their connection to the group and to each other — indeed, it has required Amy to improvise. She herself has had to be the "perceiving agent," with her own eye toward some intellectual horizon while listening carefully to and paying attention to the teachers in her own group. While we can look at the move to have teachers write vignettes as a means into an "improvisational space," we are still left with more questions than we have answered. Here we will mention three areas that call for sensitive, critical, analysis.

First, if we accept that the ability to improvise in mathematics teaching — or any "reformed" teaching — rests on a complex responsiveness to or perception of salient features, we

need to explore more carefully what the salient features are. What the "salient features" are in teaching mathematics may differ from what they are in history or science. While we might notice a similarity here to the idea of "pedagogical content knowledge", there seems to be something fundamentally different, particularly in the ability to *recognize* the salient features in context.

Secondly, if we conclude here that the writing of the vignettes served as a particular means in to developing this perception and discernment, we need to ask what it is about the writing that allows that to happen. Is writing the only medium for this? The "best" medium? Are there other structures that could work to help teachers develop the careful, disciplined looking, listening, and attentiveness they need to be able to improvise in their classrooms? On what grounds are we to judge them?

And thirdly, what is the role of the facilitator in helping teachers to refine and cultivate this improvisational perception? What kinds of skills and competencies do facilitators of teacher groups need to have and how are they to develop them? It seems clear in observing Amy's work that she brought with her a disciplined sensitivity to the particulars of this inquiry group and a responsible commitment to an ideal of what she knew teaching mathematics could be. And she made judgments along the way that respected both.

Providing professional development for teachers is a complex proposition. While we certainly can say that teachers will need to do more than cultivate a sensitive and respectful perception (in the more philosophical sense) of their mathematics classrooms to teach commensurate with reform principles , we argue that this perception is a critical piece of being able to teach wisely. How teachers come to have this perception and what the appropriate structures are for developing it are crucial questions we need to address if we hope to help teachers become "teachers of depth."

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Attachment A -- Vignette Sample

$$\begin{array}{r} 38 \\ +45 \\ \hline 83 \end{array}$$

We had been working on place value as well as addition. Students had played the game chip trading.

I asked a student to add 2 two-digit numbers that involved regrouping. She solved the problem correctly, so I asked her to explain her thinking when she solved it. She began by saying, "I started in the one's and I put the three down, I carried the one and 1 + 3 + 4 equals 8 so I got 83."

I asked the class if anyone wanted to add on or paraphrase what she had said. One boy said, "Yeah, I know what she's saying. She said that you add the numbers up first, and 8 +5 equals 13. You don't have any space to write the 13 so you have to put it somewhere ..." He was quickly interrupted by the first student that spoke. She said, "That is NOT what I was saying, I was saying that it was like chip trading. I had thirteen ones, so I traded ten to the next column for ONE ten. That's why I put the one in the tens place!"

It seemed clear to me from this discourse that she was definite about why she was carrying that "one". I'm not so sure about him. I found it very interesting how carefully she listened to his paraphrase and how clearly she understood what she had done.

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